

INSIGHT THROUGH INNOVATION



Aldrin Tan, Tracerco, Malaysia, explores the use of nucleonic instrumentation within the growing Asian petrochemical market.

The Asian petrochemical market is on the brink of a significant expansion. The growth of sectors such as construction, automotive, packaging, and textiles in the region is expected to boost the demand for petrochemical products. Countries such as China, India, Malaysia, and Indonesia are investing heavily in infrastructure, technology, and manufacturing. The International Energy Agency (IEA) says the speed and scale of the expansion of China's petrochemical sector dwarfs any historical precedent. It says that in the five years prior to 2024, China was estimated to have added as much production capacity for ethylene and propylene as existed in Europe, Japan, and Korea combined.¹

The investment in facilities such as Malaysia's RAPID complex – capable of processing up to 300 000 bpd of crude and 3 million tpy of petrochemical products – illustrates the current scale of confidence in Asia's petrochemical sector. Elsewhere in the region, South Korea's Lotte Group plans to build a large scale petrochemical complex in Indonesia, driven by a surging demand for packaging and consumer products.²

For refinery owners and operators, the Asian petrochemical market offers significant opportunities. However, meeting such an anticipated expansion in demand also presents challenges.

Maximising throughput, maintaining operational efficiency, and minimising unplanned shutdowns in complex facilities will be critical to answering growing order requirements and ensuring increased profitability. Improving process control will be essential to deal with fluctuating feedstock quality and changing process conditions. Meeting sustainability targets, such as reducing energy consumption, emissions, and chemical usage will also be

critical as regional and global environmental regulations become tighter.

To address these challenges, petrochemical asset managers and operators are increasingly turning to nucleonic instrumentation technologies to gain enhanced process insights, optimisation, and reliability. Advances in nucleonic instrumentation, supported by improved data acquisition, are enabling greater visibility. Traditionally, the deployment of nucleonic instruments has been limited to the most challenging measurement applications. However, advances in hardware and software have accelerated their use in several duties across processing units, in particular, duties involving dynamic changes in process conditions. Robust nucleonic instrumentation systems can be designed to suit most measurement applications.

Nucleonic instrumentation: a clearer view of process optimisation

Nucleonic instrumentation is a transformative technology for petrochemical operations, delivering real-time, non-intrusive measurements for fluid separation, level detection, and density monitoring. These tools can provide operators with the clarity, accuracy, precision, and reliability



needed to overcome the most challenging measurement applications.

By deploying low-energy gamma radiation, nucleonic instrumentation can provide continuous and accurate insights into the state of process fluids and interfaces inside the vessel without requiring direct contact with the process medium. This can make nucleonic instrumentation highly suitable for retrofit applications and ideal for environments experiencing extreme pressures, temperatures, and fouling often found in petrochemical facilities.

A range of nucleonic instrumentation is available for the process industry, including products for level, density, and interface measurement. This instrumentation enables operators to accurately monitor process conditions, allowing for real-time control and operational improvements in petrochemical facilities.

The Tracerco Profiler™ is a high-resolution technology-based instrument that characterises and controls real-time process conditions to provide a true profile of the fluid process. More than 750 instruments are currently deployed around the world for separation, measurement, and control of fluids in upstream and downstream assets such as FPSOs, oil and tar sands, refinery crude distillation units (CDUs), and other

applications, including subsea separation and compression systems.

The company's nucleonic instrumentation provides continuous clarity of the process conditions inside a vessel and accurate control to support reduced foaming and emulsions. The instruments can be deployed in almost any separation application where accurate control and monitoring of process phases is required for high resolution of density, bulk level, or settling solids processes. By accurately identifying hydrocarbon, water, gas, and solid phases, operators can optimise separation processes, reduce chemical usage, and improve product yield.

Tracerco™ Level+ Measurement Instrumentation is designed for liquid level, interface, and solids monitoring in upstream and downstream process vessels. It is suitable for bulk-level measurement in challenging oil, chemical, and petrochemical industry applications, including those with the potential for solids deposition and temperature and pressure extremes. This instrument is particularly effective in applications involving solid build-up, such as polymer reactors and distillation towers. By distinguishing between actual fluid levels and deposits on vessel walls, it can eliminate false level readings and prevent operational inefficiencies. False level

readings occur due to deposition or additional density materials in the process, affecting signal attenuation on the detector. The instrument overcomes this challenge due to its segmented level approach, which enables multiple measurement points across an equivalent range, when compared to traditional scintillator technology instruments using a single point of measurement.

Tracerco™ Density Measurement Instrumentation provides non-contact density measurements with no moving parts. Designed for extreme operating conditions, it offers precise and reliable data. Its ability to operate externally makes it suitable for retrofitting to older petrochemical assets such as distillation columns, stripper columns, reactors, units in purified terephthalic acid (PTA), purified isophthalic acid (PIA), and propane dehydrogenation (PDH) plants, where vessel modifications can be costly or impractical. With extended capabilities of up

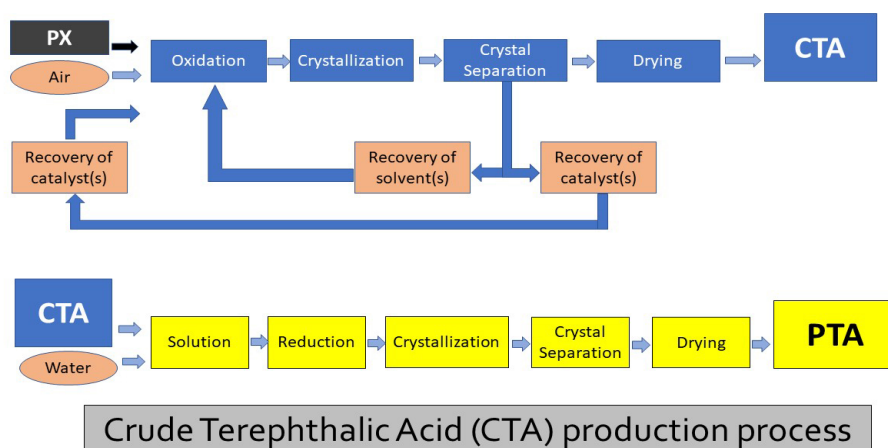


Figure 1. Diagram of the process of purified terephthalic acid (PTA).³

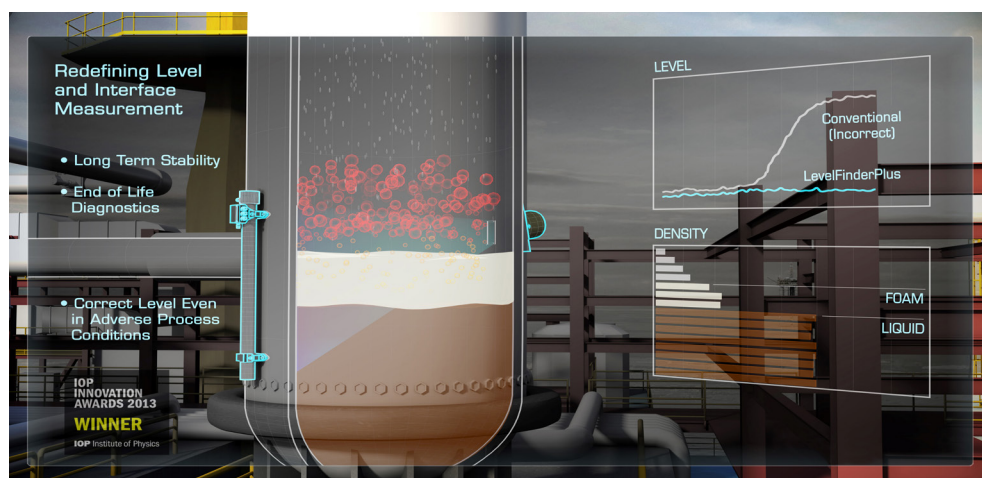


Figure 2. Tracerco's™ Level+ Measurement Instruments in a column or solvent stripper column.

to 45 m, it provides flexibility for large scale operational measurement ranges.

Advancing the petrochemical industry with nucleonic instrumentation

The greater adoption of nucleonic instrumentation enables Asian petrochemical operators to address several long-standing challenges.

Access to accurate, real-time visibility of fluid levels, densities, and interface boundaries enables operators to improve process controls such as reducing foaming and emulsions, optimising chemical dosing, minimising losses due to inefficiencies in phase separation, and controlling carry-over and carry-under to reduce environmental impact.

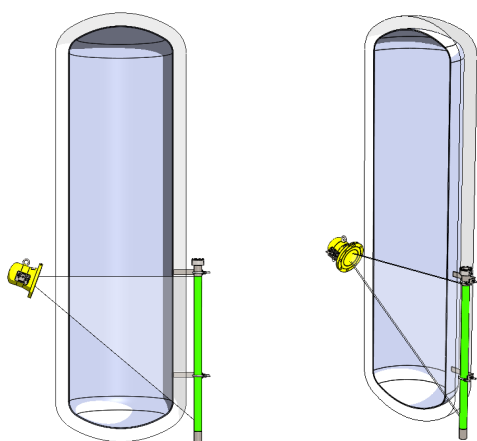


Figure 3. Tracerco's Level+ Measurement Instruments fitted onto a solvent stripper in a PTA petrochemical plant in Asia Pacific. Left image shows the front view and right image shows the side view of the vessel.

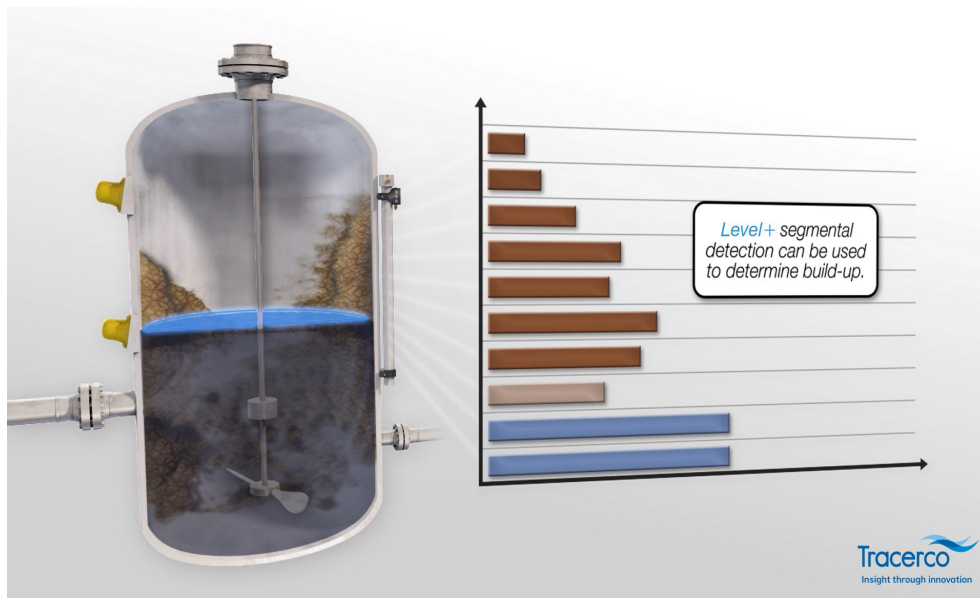


Figure 4. A separator vessel with mixer facilities when fitted with Tracerco's Level+ Measurement Instrumentation. The application is also used for multi-stage crystalliser units.

Nucleonic systems support improved operational efficiency by providing continuous, reliable data that empowers operators to optimise throughput and eliminate bottlenecks, improve overall equipment effectiveness, streamline workflows to reduce variability and maximise output, and improve resource management by reducing waste and energy consumption.

The ability of nucleonic instrumentation to reduce maintenance and downtime is a key consideration. With no moving parts and minimal calibration requirements, they can reduce costly unplanned shutdowns, avoid production delays, and extend an asset's operational performance. Instruments often operate for over 25 years with minimal intervention.

More accurate data can support company compliance with environmental and sustainability goals, including Scope 1 emissions reduction targets and net zero commitments, by helping reduce and eliminate flaring, energy consumption and emissions, and environmental risks, such as leaks and contamination.

Case study: optimising separation in petrochemical facilities

In a separation system, accurate level monitoring is crucial for effective operations and to optimise the separation of olefins, solvents, oil particles, and water, whilst removing impurities and supporting product yield.

Several blends of feedstocks may be processed at any given time, creating challenges in separation optimisation. In a petrochemical facility, there are many processes that require separation and accurate level and density measurements. Some of the petrochemical plants involve processes in manufacturing chemical building blocks such as ethylene, propylene, methane, benzene, toluene, and xylenes.

In the xylenes process, there is a process to produce PTA. Para-xylene is mixed with solvent and catalysts, and oxidised with oxygen to give terephthalic acid (TA).

In PTA applications, Tracerco's nucleonic instruments are employed to provide accurate level measurements in the oxidation reactor, crystalliser, solvent strippers, and liquid separators, amongst others. In a solvent stripper, acetic acid, that is used as a solvent in the oxidation stage, is recovered by vaporising it from the liquid mixture that contains the crystallised TA.

The Level+ Measurement instruments are utilised in an Asian petrochemical site, in the solvent stripper to enable accurate level measurements for the liquid and the crystallised TA in the mixture. The recovered solvent (acetic acid) is then

recycled back to the oxidation reactor, reducing the loss of the solvent and increasing the process efficiency. Installed for more than two decades, the instruments have provided reliable measurements to drastically improve what was a challenging process for conventional instrument systems.

The detector is fitted with the Geiger-Muller technology in a segmented configuration, mounted to the vessel in a non-process contact arrangement. The segmented detection approach in Tracerco's nucleonic devices enables the client to have a more effective and accurate monitoring of their solvent stripper process, on which multiple measurement points are made available at their desired elevations within the vessel.

With this operational advantage, petrochemical assets can continue maximising TA output and reap lower operational expenses with reduced losses in their solvent system. Other nucleonic instrument applications encompass other process units such as the oxidation reactors, crystalliser, slurry receiver, and other related separators in the petrochemical facility.

The way ahead for data insights

The integration of technologies such as advanced digitalisation and artificial intelligence (AI) has the potential to unlock even greater opportunities for process optimisation and smarter decision-making in the Asian petrochemical industry.

AI-powered predictive analytics could potentially use data from nucleonic instruments to predict anomalies and equipment failures before they occur, optimise operating conditions for improved performance, support proactive maintenance plans, and reduce unplanned disruptions.

Developments in digital connectivity could support remote monitoring by allowing operators to monitor process data from centralised locations anywhere in the world. Future advances in sensor technology may provide even greater resolution and accuracy, allowing operators to detect and respond to the most minute changes in process conditions to ensure consistent production quality.

More clarity, accuracy, and efficiency

As the Asian petrochemical market grows, the need for greater process optimisation, performance accuracy, and reduced environmental impact will intensify. Nucleonic instrumentation technologies can provide the precision, reliability, and longevity needed for the region's petrochemical industry to meet these challenges.

Adopting advanced digital technologies, AI, remote monitoring, and data-driven analytics will further amplify the value of nucleonic instrumentation in empowering operators to build resilient, efficient, and sustainable operations for the future. 

References

1. HEALEY, C., 'China's petrochemical surge is driving global oil demand growth,' *International Energy Agency*, (19 December 2023) <https://www.iea.org/commentaries/china-s-petrochemical-surge-is-driving-global-oil-demand-growth>
2. 'S. Korea Lotte Chemical to build \$3.9 bln petchem project in Indonesia', *Reuters*, (7 January, 2022) <https://www.reuters.com/business/energy/skoreas-lotte-chemical-form-petchem-project-indonesia-worth-39-bln-2022-01-07/>
3. <https://www.valcogroup-valves.com/faq-2/pta-terephthalic-acid-manufacturing-process-of-pta/>